50572-85

SPECIFICATION ACCEPTED AND AMENDMENTS ALLOWED 28-10-88

FORM 1

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

I/We, ROHR GmbH

of Franz-Kirrmeier-Str. 17, 6720 Speyer, Federal Republic of Germany,

LODGED AT SUB-OFFICE 2 - DEC 1985 Melbourne

hereby apply for the grant of a standard patent for an invention entitled :- DREDGER.

which is described in the accompanying ~~provisional~~/complete specification.

Details of basic application(s):

Number of basic application	Name of Convention country in which basic application was filed	Date of basic application
P 34 45 610.4	Federal Republic of Germany	14th December, 1984.
P 35 01 078.9	Federal Republic of Germany	15th January, 1985.

LODGED AT SUB-OFFICE 2 DEC 1985 Melbourne

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My/our address for service is care of CLEMENT HACK & CO., Patent Attorneys, 140 William Street, Melbourne, Victoria, 3000, Australia.

DATED this 29th day of November, 1985.

ROHR GmbH.

CLEMENT HACK & CO.

To: The Commissioner of Patents.

PF/App/6/84

AUSTRALIA

Patents Act 1952

DECLARATION IN SUPPORT OF A CONVENTION OR NON-CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

Name(s) of applicant(s)

In support of the application made by ROHR GMBH

Title

for a patent for an invention entitled "DREDGER"

Name(s) and address(es) of person(s) making declaration

I/~~We~~, Wolfgang ROHR
of Zeppelinstr. 16
6720 Speyer
Germany
do solemnly and sincerely declare as follows:-

1. I am/~~we are the applicant(s) for the patent, or~~ ~~am/are~~ authorised by the abovementioned applicant to make this declaration on its behalf.

2. The basic application(s) as defined by Section 141 of the Act ~~was~~/were made in the following country ~~or countries~~ on the following date(s) by the following applicant(~~s~~) namely:-

Country, filing date and name of Applicant(s) for the or each basic application

in Federal Republic of Germany on 14th December 1984
by ROHR GMBH
in Federal Republic of Germany on 15th January 1985
by ROHR GMBH

3. The said basic application(s) ~~was~~/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

Name(s) and address(es) of the or each actual inventor

4. The actual inventor(~~s~~) of the said invention is/~~are~~
Wolfgang ROHR
Zeppelinstr. 16
6720 Speyer
Germany

See reverse side of this form for guidance in completing this part

5. The facts upon which the applicant(~~s~~) is/~~are~~ entitled to make this application are as follows:-
The applicant would be entitled to have assigned to it a patent granted to the actual inventor in respect of the said invention.

DECLARED at Speyer/Rh. this 30th day of August 19 85

Rohr GmbH

X

Wolfgang ROHR

This form may be completed and filed after the filing of a patent application but the form must not be signed until after it has been completely filled in as indicated by the marginal notes. The place and date of signing must be filled in. Company stamps or seals should not be used.

No legalisation is necessary

(12) PATENT ABSTRACT (11) Document No. AU-A-34502/89
(19) AUSTRALIAN PATENT OFFICE

(54) Title
DRAGLINE APPARATUS AND METHOD OF EXCAVATION

(51)[4] International Patent Classification(s)
E02F 003/60 E02F 003/48 E21C 047/00 B65G 047/13

(21) Application No. : 34502/89 (22) Application Date : 06.05.88

(23) Filing Date of Complete Specification : 08.05.89

(43) Publication Date : 09.11.89

(50) Related to Provisional(s) : PI8139

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(57) Claim

1. An excavator bucket having a body which includes selectively actuatable door means movable from an open position to a closed position and vice versa.

13. A cable support system for use with a dragline including:

(i) a dragline excavator bucket;

(ii) one or more hoist cables supportable by the dragline and actuatable by a hoist winch associated with a movable housing of the dragline;

(iii) one or more drag cables supportable by the dragline and actuatable by a drag winch associated with the movable dragline housing; and

(iv) one or more vertical dumping cables supportable by the dragline and attached to an open front end of the excavator

bucket above an access mouth thereof.

21. A method of excavation of a mineral deposit utilizing a dragline including the steps of:

(i) using a first dragline for prestripping wherein excavated prestrip material is loaded onto conveying means by the dragline to provide a support bench; and

(ii) using the same or a second dragline supported by the support bench in step (i) to excavate material or overburden from a mineral deposit site.

28. A hopper system for use in the method of claim 21 including:

(i) a hopper body having an open top;

(ii) discharge means for discharging material loaded into the hopper body into conveying means located below the hopper body; and

(iii) support structure for the hopper body including a passageway located below the hopper body for location of the conveying means.

COMMONWEALTH OF AUSTRALIA

The Patents Act 1952-1969

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COMPLETE SPECIFICATION FOR THE INVENTION ENTITLED:

DRAGLINE APPARATUS AND METHOD OF EXCAVATION

The following statement is a full description of the invention including the best method of performing it known to us:

This invention relates to improved dragline apparatus and a method of excavation using the dragline apparatus.

Conventional draglines include a dragline housing which incorporates a hoist winch, an outwardly extending boom carrying a hoist cable connected to the hoist winch which may extend downwardly from an outer end of the boom attached to an excavator bucket as hereinafter described and a drag cable attached to the excavator bucket which is connected to a drag winch located in the dragline housing. Both the drag winch and hoist winch are suitably driven from electric motors and the dragline housing is suitably rotatably mounted to a support base by a central bearing. The dragline housing may be equipped with crawler tracks for locomotion or alternatively and more commonly is equipped with a walking mechanism having a pair of support feet which are reciprocable relative to the dragline housing and thus may propel the dragline housing in a desired direction of travel.

The excavator bucket usually has a base wall which is generally arcuate in side view surrounded by an upright side wall which is provided with an open front or access mouth whereby soil or overburden may gain access to the interior of the bucket as the bucket is dragged or moved through loose overburden by drag cable(s). A plurality of ripper teeth along a free edge of the base wall may be provided in the open front or access mouth.

A rear end of the excavator bucket is provided with a pair of opposed hoist chains each attached to a respective support lug on an external face of the upright side wall. The chains may be interconnected by a substantially horizontal spreader bar. The hoist cables may be attached to a mounting point above the centre of the horizontal bar to a single hoist cable which engages with the hoist winch of the dragline housing.

There also may be provided an attachment lug of the excavator bucket on an arched portion thereof above the open front of the bucket to which may be attached a further cable known as a "dump rope". There also may be a dump sheave which engages with the dump rope which is attached to the hoist cable. There also may be provided a pair of drag chains attached to each front corner portion of the excavator bucket below the dump rope. Each drag chain may have a return portion which is attached to a front spreader bar which also engages with the dump rope. Each drag chain is also attached to an associated drag rope which engages with the drag winch of the dragline housing.

The abovementioned conventional dragline operates to remove overburden or to mine a mineral from a valuable mineral or coal deposit such as a coal seam. After initially drilling and blasting the overburden by a suitable explosive such as ammonium nitrate, the overburden is loosened and softened. A bulldozer was then used to level a portion of

the overburden to provide a flattened hill for supporting the dragline housing. The excavator bucket was then moved to the desired location wherein the drag winch was free spinning so that the drag cable was slack. In this movement the hoist winch has enough tension to hold the excavator bucket as it swings freely when suspended from the boom. Then the excavator bucket is placed on the ground by actuation of the hoist cable and tension is subsequently applied to the drag cables. The bucket is subsequently dragged through the loose overburden until it is full. The tension is then maintained in the drag cables and tension is applied to the hoist cables to elevate the full bucket above the overburden. By balanced control of the hoist winch and drag winch the bucket may then be moved towards the top of the boom which has a sheave for supporting the hoist cable. The dragline housing is then pivoted away from the excavation site towards a spoil pile or dump. The overburden is subsequently tipped out of the excavator bucket by slackening of the tension in the drag cables and at a position that is close to a perimeter path described by the end of the boom rotating about the dragline housing. This activity is known as "Perimeter Dumping". By appropriate control of the hoist cable the empty excavator bucket then assumes its normal orientation and is then moved back to the excavation site by rotation of the dragline housing.

In this dumping action the excavator bucket pivots

about the pivot axis defined by each hoist chain support lug or trunnion to assume a vertical orientation whereby the overburden passes through the open front of the excavator bucket. The dumping action is controlled by the dump rope.

The abovedescribed conventional dragline apparatus has several disadvantages and one major disadvantage was that it was constrained by geometric or physical size parameters such as the length of the hoist cable(s) and drag cable(s) and/or the length of the boom at the excavation site. Thus for example, if a coal seam was too deep for the cables then "rehandling operations" were necessary wherein material already removed or dug by the excavator bucket is dug again by auxiliary or companion excavation equipment such as a bucket wheel excavator or repositioning of the dragline. Thus in relation to a particular mine if the coal seam was too deep for the physical parameters of the machine it was necessary to carry out a prestripping operation by truck and shovel, bucket wheel excavator or scraper to remove the top level of overburden. Rehandling or prestripping operations were found to be very expensive in practice and insufficient in relation to the depth of the open cut excavation site. Thus in other words, as depth increased, there was a tendency for the spoil pile and high wall excavation material separating the excavation site and the flattened hill supporting the dragline housing to subside and fall into the open cut excavation site.

Reference may also be made to prior art which includes Australian Patent 502973. Australian Patent 502973 refers to a hopper structure which straddles a conveyor means for transporting excavated material. The hopper structure is shiftable along the conveyor means and adapted to receive the excavated material from an excavator bucket of a dragline so as to load the material onto the hopper means. This operation is subsequently repeated wherein the hopper structure, after each excavation operation, is shifted along the conveyor means by a certain distance and subsequently fixed in place. It is considered that the method of excavation and associated hopper structure described in this specification is rather complicated, especially in regard to shifting the hopper structure along the conveyor means which is not necessary in the present invention as described hereinafter.

Reference may also be made to Australian Patent 501008 which is considered not to be relevant to the present invention in that it is unduly complicated including a hopper means mounted on a dragline housing, a guide means for guiding an excavator bucket to a position over the hopper means and a loading means disposed below the hopper means for receiving and transferring excavated material into an adjacent transport means.

Reference may also be made to USSR Specifications 1266930, 1249115, 1142599, 1006647 and 853021 as well as US

Specifications 3740875, 3531088, 3744615, 3258865 and 3517841 which are not believed relevant to the present invention.

It therefore is an object of the invention to provide cable support system for a dragline apparatus which may alleviate the abovementioned disadvantages associated with the prior art.

It is a further object of the invention to provide a method of excavation which may alleviate the abovementioned disadvantages of the prior art.

It is a further object of the invention to provide an excavator bucket which may be used in the cable support system and method of excavation of the invention.

A further object of the invention is to provide a hopper apparatus suitable for use in the method of excavation of the invention.

The excavator bucket of the invention which constitutes a first aspect of the invention includes a body characterised in that there is provided selectively actuatable door means movable from an open position to a closed position and vice versa and optionally screening means for screening of material before exiting from the bucket when the door means is in the open position.

The body of the excavator bucket is suitably open topped and has a pair of upright and opposed side walls. The bucket of the invention as is the case with the conventional bucket may have an open front optionally associated with a

plurality of digging teeth or tynes. Alternatively the digging teeth may be replaced by a single digging blade or other suitable excavation means.

The body is preferably substantially rectangular in plan and as is the case with the conventional excavator bucket be provided with opposed pivot attachments for each hoist chain such as trunnions and the like.

The body may also be provided with an arched portion located above the open front having a support lug for attachment of the dump rope. There also may be provided a pair of opposed attachment lugs adjacent the open front for attachment of a pair of drag chains.

The selectively actuatable door means is suitably located in the rear part of the excavator bucket and in one form may comprise an end rear door or flap. However an alternative location for the door or flap may be in a base wall of the body of the excavator bucket. Preferably however the former is preferred.

The door means may be operated in any suitable manner and thus in one embodiment may move linearly relative to the body such as upwardly or downwardly so as to provide an exit opening. More preferably however the door is pivotally attached to the body by a hinge or other suitable pivot means. Preferably the hinge is provided in the body above the door so that the door may pivot outwardly and upwardly relative to the body. However, it will be

appreciated that the door may pivot relative to the body in an other suitable direction. For example the door may have a vertical rotational or pivot axis as opposed to a horizontal pivot axis as defined above in regard to an outer and upward pivotal movement.

The door means may also be provided with suitable locking means when in the closed position and for this purpose a remote controlled locking means may be provided.

The screening means may be any suitable type and is suitably located in advance of the door means and adjacent to the door means.

The screening means in one arrangement may comprise a perforated sheet or mesh screen. A more suitable screening means is a lattice work of screen bars which may be oriented in any desired direction. Preferably however the screening means is releasably attachable to the body. In a particularly preferred arrangement there may be provided a plurality of vertically oriented screen bars each located in suitable sockets in the body. In this arrangement there also may be provided a plurality of horizontally inclined screen bars also suitably located in suitable sockets in the body.

In use the excavator bucket may be attached to the hoist cable(s) and drag cable(s). The geometry of the dump rope(s) may be altered to permit the bucket to be carried at a more laid back angle than in usual dragline operation. The abovementioned locking means may be opened by a trip wire

mechanism, a radio signal relay system, or an electric current supply to a suitable latch motor drive. When the latch is actuated, the door swings open and the load discharges through the rear of the bucket. The opening mechanism may be actuated anywhere in the annulus range of the bucket swing around the dragline, so this activity also constitutes another example of "Close Dumping" as described herein. In regard to the screen bars, individual bars may be held in position by a clip mechanism which permits individual bars to be removed or installed, thereby matching the screening ability of the screen bars with the screening characteristics of the overburden. Large rock material may be retained on the screen bars for disposal by other means, most usually by front discharge from the bucket onto a spoil pile, or into an open pit excavation.

In a second aspect of the invention there may be provided a cable support system for use with a dragline including a dragline excavator bucket attached to hoist cable(s) and drag cable(s) as discussed previously. In this aspect of the invention the excavator bucket may be a conventional bucket or an excavator bucket as described above in the first aspect of the invention.

The second aspect of the invention is characterized by the provision of one or more dumping cables supportable by the dragline and attached to an open front end of the excavator bucket above an access mount thereof. The dumping

cable(s) may therefore replace the aforementioned conventional dump rope.

The dragline apparatus may also include support means for the dumping cable(s) located on the dragline boom or associated with the dragline housing which is suitably winch means such as a torque winch. Preferably a single dumping cable is used which is attached to and actuated by the torque winch.

In one suitable arrangement the dumping cable may extend to the top of the boom and thence to the torque winch in a similar manner as the hoist cable(s).

In this aspect of the invention there also may be provided a spacer member suitably of variable length interposed between the dumping cable and a horizontal spreader bar or other support used for spreading the hoist cables or more suitably a pair of hoist chains interconnecting the hoist cables to the excavator bucket.

In a preferred arrangement the spacer member may be telescopic having a predetermined minimum length.

In this aspect of the invention there also may be provided at least one restraint cable interposed between the drag cables, or more suitably a pair of drag chains interconnecting the hoist cables to the excavator bucket and a drag chain spreader bar and the hoist chain spreader bar. In this aspect of the invention, as mentioned above, the dump rope and also the dump rope sheave may be omitted.

Preferably there is provided a pair of restraint cables interposed between the ends of the hoist chain spreader bar and appropriate locations on each return drag chain or front (i.e. drag chain) spreader bar.

In this aspect of the invention discharge from the bucket occurs when the dumping cable attached to the torque winch is released thereby allowing the front of the bucket to tip forward and discharge the load. The outward swinging movement of the emptying bucket normal in dragline operations may be resisted by the drag cable connection onto the horizontal bar position in the hoist cables. This activity is described as "Close Dumping:" and is noticeably different to the Perimeter Dumping method described previously. Alternatively, if two hoist cables are used to support the rear of the bucket it is possible to position one cable onto the front of the bucket and leave the other cable to support the rear of the bucket. Discharge of the bucket is then accomplished by shortening the rear cable (or lengthening the front cable) which allows the bucket to tip forward and discharge the load. In this embodiment it therefore will be appreciated that either hoist cable may function as a dumping cable.

In the aforementioned second aspect of the invention the excavator bucket may be of the conventional type as described above or alternatively the excavator bucket may be in accordance with the first aspect of the invention

which however is suspended in the manner described above in relation to the second aspect of the invention.

In a third aspect of the invention, there is provided a method of excavation of a mineral deposit utilizing a dragline including the steps of:

(i) using a first dragline for prestripping wherein excavated prestrip material is loaded onto conveying means by the dragline to provide a support bench; and

(ii) using the same or a second dragline supported by the support bench in step (i) to excavate material or overburden from a mineral deposit site.

In this third aspect of the invention the excavated prestrip material may be transported by conveyor or motorised transport from the excavation site to a suitable spoil dump. Suitably the excavated prestrip material may be loaded into a hopper which may be connected to a suitable crusher by feeding means such as a plate feeder. Thereafter the crushed material may be loaded onto a spoil conveyor. Alternatively the excavated material may be uncrushed before loading onto the spoil conveyor.

In this third aspect of the invention the prestripping may be carried out after initial blasting by a first dragline so as to remove a prestrip bench ahead of the support bench or second dragline bench which supports a second or the same dragline which may be used for mining or excavating a coal seam or other mineral deposit as set out

above in step (ii).

In an alternative arrangement to that described above using the spoil conveyor, the excavated material may be transported away to a spoil pile by transport means which include tracked vehicles such as rail trucks or untracked vehicles such as trucks. Suitably a hopper is used for transferring the excavated material to the transport means. The hopper may also be used for storage purposes. The excavated material if desired may be crushed before being loaded onto the spoil pile or crushed before being loaded.

Thus the invention may also include within its scope a fourth aspect which refers to a hopper system including:

(i) a hopper body having an open top;

(ii) discharge means for discharging material loaded into the hopper body into conveying means located below the hopper body; and

(iii) support structure for the hopper body including a passageway located below the hopper body for location of the conveying means.

Preferably the hopper system is fitted with a feeder means which receives material dumped from a dragline bucket and then feeds it to the conveying means which may comprise a conveyor or mine truck. Alternatively the material may be crushed by crushing means associated with the hopper body before being passed to the conveying means. The

hopper system support structure may also be equipped for movement in any desired direction and in one form the hopper support structure may be moved by a pair of reciprocating feet as described for the dragline. The hopper support structure may be supported by a set of opposed crawler tracks or an arrangement of steerable wheels. Also the hopper support structure may be suitable for sliding along the ground by connecting a suitable pulling bridle to the dragline bucket and then using the drag winches to provide the sliding force.

There is now shown and illustrated in the attached drawings a preferred embodiment of the invention. In the drawings:-

FIG 1 represents an isometric view of a process in accordance with the third aspect of the invention;

FIG 2 represents an isometric view of an excavator bucket constructed in accordance with the invention;

FIG 3A represents a side elevation of the excavator bucket shown in FIG 2;

FIG 3B represents a rear end elevation of the excavator bucket shown in FIG 2;

FIG 4 represents a side elevation showing the operating range of the excavator bucket shown in FIG 3;

FIG 4A represents an annulus showing the operating range of the excavator bucket shown in FIG 4;

FIGS 5 & 5A represent a plan view and side view of

a conventional excavator bucket;

FIG 6 represents a side elevation showing the operating range of the cable support system constructed in accordance with the second aspect of the invention;

FIG 6A represents a side view of the attachment points of the excavator bucket utilized in the cable support system shown in FIG 6;

FIG 7 shows a similar view to FIG 6 but representing a variation in regard to the second aspect of the invention;

FIGS 8 & 9 represent a side elevation and end elevation respectively of a hopper system constructed in accordance with the fourth aspect of the invention;

FIG 10 represents a side elevation of the excavation method of the invention in accordance with the third aspect thereof loading a hopper system as shown in FIG 7;

FIG 10A represents a road train conveying means used in relation to the hopper system shown in FIG 10;

FIG 10B represents a side elevation of the hopper apparatus being moved by the dragline in accordance with the fourth aspect of the invention; and

FIG 11 represents a side elevation showing the operating of a "Close Dumping" dump bucket operation in accordance with the first or second aspect of the invention and illustrates comparative details between the close dumping bucket and the

perimeter dumping bucket.

In the isometric view of the process of the invention shown in FIG 1, there is shown a dragline 10 loading a hopper 11 with feeder 12 loading into a crusher 13, which loads onto a prestrip conveyor system 14. Material from the conveyor system is deposited by the spreader 15, onto existing dragline spoil material 17. The prestrip bench 18 is removed ahead of the dragline bench 19, which permits the dragline 20 to operate in a side casting role to uncover coal 21. The overburden material 22 is prepared by drilling and blasting represented by overburden drill 23.

An alternative process is represented in FIG 10 which shows dragline 10, loading into truck hopper system 24, which is loading into mine truck 25. A road train vehicle 16 is depicted in FIG 10A to indicate the style of hauling unit suitable for use with this system. The road train unit is possible because the dragline 10 can dig large bench heights 18, which reduces the ramping requirements for haul trucks collecting overburden from dragline 20. Reduced ramping requirements enables larger loads to be carried on the trucks, thus permitting an improved truck hauling system. The dragline 10 is shown dumping in the Perimeter Dumping mode using a conventional dragline bucket rigging procedure.

The excavator bucket of the invention is shown in FIGS 2, 3A & 3B, where 27 is the arch or high transverse support of the bucket 28, 29 are the lugs where the drag

ropes are attached to and 30 are the digging teeth at the front of the bucket. The trunnion mounts 31 are situated on either side of the bucket 28 and connect to the hoist cables. Horizontal and vertical screen bars 21 and 22 are independently removable. The screen bar arrangement enables a prescreening of lump material ahead of the hopper complex. This avoids the delay to prestripping operation that would otherwise be encountered when oversize material lodges in the hopper system. Discharge of the material retained on the screen bars is achieved by positioning the bucket over a spoil dump and tipping the bucket forwards, thus permitting the large rocks to fall out the open front end 32 of the bucket through access mouth 33. The rear door 34 is pivotally attached to the bucket at hinge 35, and the door is held closed by latch clip 36. The operation of the latch is controlled by the remote control locking mechanism 37.

In FIGS 4, 5 & 5A, there is shown conventional excavator bucket 60 showing dump sheave 61 connected to hoist cable 63 by an appropriate bracket (not shown). Also shown are hoist chains 62 and front spreader bar 64. Also shown is dump cable 65 and drag chains 66. Drag chains 66 each have a return portion 67 attached to rear spreader bar 68. Also shown are drag cables 69 as well as trunnions 70, open front 71, excavator teeth 72, transverse arch 73 and dump rope attachment lug 74. The excavator bucket 60 has a body 75 substantially rectangular in plan as shown and a box wall 76

substantially arcuate in side view as shown.

The excavator bucket as shown in FIG 3 can operate in a close dumping mode as shown in FIG 4, where 37 is the maximum bucket dump position and 38 represents the minimum dump radius. The annulus (shown as a semi annulus for convenience) of dump range positions is shown by the shaded plan view 39 in FIG 4A. The dragline 10 shown in FIG 4 includes boom 41, movable dragline housing 42, support frame 43, hoist cable(s) 63 and drag cables 62.

The cable support system in accordance with the second aspect of the invention can operate in a close dumping mode as shown in FIG 6, where 50 shows the bucket dumping in a perimeter position, 51 shows the bucket in carry position and 52 shows a loading action for the bucket in relation to incline 52A. Also shown is horizontal restraint cable 62A as well as vertical dump cable 63A. Vertical dump cable 63A is controlled by torque winch 65A as well as sheave 66A. Spacer bar 67A is positioned between the centre of the hoist spreader bar 64 and a fixed point on the torque winch cable 63A. The spacer bar 67A serves to maintain a minimum set distance between cables 63 and 63A which serves to maintain tipping control over the bucket 28 during bucket discharge. Also shown in FIG 6A is the shifting of trunnion mount 70 from A to B.

A further refinement of the tipping mechanism on a dragline with two or more hoist cables 63 involves

replacement of cable 63A with one of the hoist cables 63, as shown in FIG 7. In this adaptation of the invention, the bucket tipping action is controlled by shortening the hoist cable 63D relative to the hoist cable 63C. A suitable mechanism for this action would consist of an intermediate sheave 58A, mounted on a radial arm 59A, sliding rack or similar. The radial arm 59A is operated by hydraulic ram 57A, or similar mechanism. The sheave 58A is placed on either cable 63C or 63D and serves to alter the length of either cable by operation of the radial arm 59A, sliding rack or similar mechanism.

The apparatus shown in FIGS 6 or 7 enables the dragline to hoist a larger capacity bucket than is normally the case with conventional dragline bucket rigging. This occurs because the normal bucket relies on tension in the drag cable(s) 62 to maintain the attitude of the bucket before tipping occurs. This tension has a downwards component on the hoist cable(s) 63 which therefore limits the load which can be lifted in the dragline bucket. The attitude of the bucket shown in FIGS 6 or 7 is maintained by tension in hoist rope 63A or 63D, which also assists in lifting the bucket 28. The hoisting capacity released by fitting a bucket 28 shown in FIGS 6 or 7 can therefore be utilised by fitting a larger dragline bucket. The ability to independently lift the front of the bucket 28 also represents an improvement over the conventional dragline operation in

that the dragline bucket can be lifted out of the overburden as soon as the driver sees that the bucket is full, whereas with the existing bucket rigging the bucket has to be drawn into the dragline housing before the rope geometry permits the bucket to be raised from the ground. The invention therefore permits fast cycling with a dragline fitted with a bucket cable rigging shown in FIGS 6 or 7.

It will be obvious that a further refinement of the invention would be to rig a bucket shown in FIG 2 with a cable rigging arrangement shown in FIGS 6 or 7. Such a bucket would have large capacity as well as automatic coarse screening capabilities.

A hopper system or dragline truck loading station is shown in FIGS 8 and 9 and consists of a large open topped bin 77, supported on a suitable structure 78. The opening in the base of the bin 77 is controlled by a door mechanism 79, which permits controlled discharge of the bin contents into haul truck 80. The bin 77 is built on a floor structure 81 and may include a suitable locomotion system such as a set of opposed tracks, a walking mechanism, or a wheel mechanism 82. The power requirements for the bin 77 may be supplied from a power module 83, and/or through a trailing cable device supplying electric power. The bin 77 is suitably protected on the inside by wear plates, or a 'rock box' design (not shown) and a clean down facility such as compressed air injection pipes 85 are fitted to remove the contents of the

rock box thereby decreasing the load prior to shifting the bin 77. The sides of the bin 77 are protected by spill deflector structures 86 from possible premature discharge of the dragline bucket, and the arcuate path of the dragline bucket is restrained from possible overrun by a bucket overrun protection structure 87. There is also shown passageway 88 for vehicle 80.

The operation of the hopper apparatus shown in FIG 8 is shown in FIG 10 wherein bucket 28 of dragline 10 is shown loading excavated material into hopper or bin 77. Road train 91, shown in FIG 10A, illustrates the type of truck vehicle which can be operated with this loading system. FIG 10 shows the bin being loaded in the perimeter dump position, but it could be situated closer to the dragline when the dragline is fitted with a close dumping bucket arrangement as discussed in the invention.

The truck hopper unit or bin 77 in a non mobile situation may be shifted by using the winches fitted to the dragline. Such an arrangement is shown in FIG 10B where the truck hopper 77 is connected to the dragline by the hoist cables 63 and the drag cables 62. A pulling bridle 92 is suitably arranged to fit over the teeth of the dragline bucket 28, and connected to a pulling cable(s) 93 attached to the truck hopper 77. The hopper 77 is shifted by positioning the dragline bucket in the bridle 92 and then pulling the dragline ropes until the hopper 77 approaches the dragline

boom structure. Then the tension in the ropes is released while the dragline takes several steps backwards to a new vantage point. Then the hopper is drawn towards the dragline again, and so on.

The distinction between the perimeter dumping process and the close dumping process is further illustrated in FIG 11. The dragline 10 is fitted with a bucket 28 in accordance with the invention. The hinged door 34 is shown in the open position which permits the bucket contents to discharge into a low level hopper/feeder 95. The close dump position is compared with alternate position of the bucket and hopper if situated at the perimeter dumping position 97 shown in phantom. The rear dump bucket 26 in this example is fitted with a trip wire 96 used to activate the door latch mechanism on the bucket. There is also shown elevator 98 and downwardly oriented conveyor 100 feeding excavated material 99 into hopper.

In regard to the preferred embodiment of the invention, it will be appreciated that advantages applicable to various aspects of this invention include the following:-

(i) deep seams of mineral may be uncovered;

(ii) the overburden may be transported horizontally over varying radius distances before dumping the contents into a hopper or truck;

(iii) larger trucks may be specially designed for low angle ramping duties;

(iv) larger buckets may be fitted to draglines;

(v) dragline buckets may be loaded and lifted in a more rapid fashion;

(vi) larger buckets with screens may be fitted to draglines;

(vii) the process of the invention allows for removal of prestrip overburden ahead of a dragline;

(viii) draglines may load into hoppers positioned for close dumping or perimeter dumping;

(ix) screening facilities within the bucket structure may be provided; and

(x) large trucks may be loaded by large dragline equipment.

In the foregoing drawings, cables drawn in phantom indicate that they are slack, whereas when they are drawn in full outline this means that they are taut.

It will also be appreciated that the term "cable" as used herein includes within its scope any flexible line member such as a rope, chain, wire cable and the like.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An excavator bucket having a body whi includes selectively actuatable door means movable from an open position to a closed position and vice versa.

2. An excavator bucket as claimed in claim 1 wherein the body has a continuous side wall surrounding an open top and there is further provided an open front or leading end.

3. An excavator bucket as claimed in claim 2 wherein there is further provided excavating means adjacent the open front end.

4. An excavator bucket as claimed in any one of claims 2 or 3 wherein the door means is located in a rear end of the body in substantially opposed relationship to the open front.

5. An excavator bucket as claimed in claim 4 wherein the door means is hingedly attached to the body so as to pivot outwardly and upwardly relative to the body.

6. An excavator bucket as claimed in any preceding claim further including screening means for screening of material in use before said material exits from the bucket when the door means is in the open position.

7. An excavator bucket as claimed in claim 6 wherein the screening means in located adjacent to and in advance of the door means.

8. An excavator bucket as claimed in claim 7 wherein the screening means comprises a lattice work of screen bars.

9. An excavator bucket as claimed in claim 8 wherein

the lattice work comprises a plurality of substantially vertically oriented screen bars as well as a plurality of substantially oriented screen bars.

10. An excavator bucket as claimed in any one of claims 6 to 9 wherein the screening means in releasably attachable to the bucket.

11. An excavator bucket as claimed in any preceding claim wherein the door means is provided with remote controlled locking means to permit opening of the door means for discharge of material when required.

12. An excavator bucket substantially as herein described with reference to the accompanying drawings.

13. A cable support system for use with a dragline including:

(i) a dragline excavator bucket;

(ii) one or more hoist cables supportable by the dragline and actuatable by a hoist winch associated with a movable housing of the dragline;

(iii) one or more drag cables supportable by the dragline and actuatable by a drag winch associated with the movable dragline housing; and

(iv) one or more vertical dumping cables supportable by the dragline and attached to an open front end of the excavator

bucket above an access mouth thereof.

14. A cable support system as claimed in claim 13 wherein said one or more dumping vertical cables are attached to an actuatable by a torque winch associated with the movable dragline housing.

15. A cable support system as claimed in claim 13 wherein said one or more vertical dumping cables comprises a hoist cable which is shortened relative to an associated hoist cable to control dumping or tipping of the excavation bucket.

16. A cable support system as claimed in any one or claims 13 to 15 further including one or more horizontal restraint cables which may interconnect said one or more drag cables adjacent the excavator bucket in use to a hoist cable spreader bar above the excavator bucket in use.

17. A cable support system as claimed in claim 15 further including a spacer member interconnecting said one or more hoist cables and said one or more vertical dumping cables so as to maintain said one or more hoist cables and said one or more vertical dumping cables at a set distance to maintain tipping control over the excavator bucket.

18. A cable support system as claimed in any one of claims 15 to 17 wherein there is provided a movable control sheave for controlling movement of said shortened hoist cable or another hoist cable.

19. A dragline including a movable dragline housing and

incorporating a cable support system as claimed in any one of claims 13 to 18.

20. A dragline including a movable dragline housing and incorporating a cable support system as claimed in claim 14 and further including a torque winch for supporting and actuating said one or more vertical dumping cables.

21. A method of excavation of a mineral deposit utilizing a dragline including the steps of:

(i) using a first dragline for prestripping wherein excavated prestrip material is loaded onto conveying means by the dragline to provide a support bench; and

(ii) using the same or a second dragline supported by the support bench in step (i) to excavate material or overburden from a mineral deposit site.

22. A method of excavation as claimed in claim 21 wherein the prestrip material is crushed for being loaded onto said conveying means.

23. A method of excavation as claimed in claims 21 or 22 wherein the conveying means comprises a conveyor belt transporting excavated prestrip material to a spoil bank.

24. A method as claimed in claim 21 or 22 wherein the conveying means includes a mobile vehicle with ground engaging wheels.

25. A method as claimed in any one of claims 21 to 24

wherein the first dragline is operated in a close dumping mode as well as a perimeter dumping mode in step (i).

26. A method of excavation substantially as herein described with reference to the accompanying drawings.

27. A cable support system as claimed in claim 13 substantially as herein described with reference to the accompanying drawings.

28. A hopper system for use in the method of claim 21 including:

(i) a hopper body having an open top;

(ii) discharge means for discharging material loaded into the hopper body into conveying means located below the hopper body; and

(iii) support structure for the hopper body including a passageway located below the hopper body for location of the conveying means.

29. A hopper system as claimed in claim 28 wherein the support structure is provided with movable ground engaging means thereby providing a mobile hopper system.

30. A hopper system as claimed in claim 28 or 29 wherein the discharge means includes one or more discharge doors located in a base part of the hopper body movable from an opening position to a closed position and vice versa.

31. A hopper system as claimed in claim 28

substantially as herein described with reference to the accompanying drawings.

DATED this eighth day of May, 1989.

AUSTRALIAN COAL INDUSTRY
RESEARCH LABORATORIES LTD.
By their Patent Attorneys
G.R. CULLEN & COMPANY

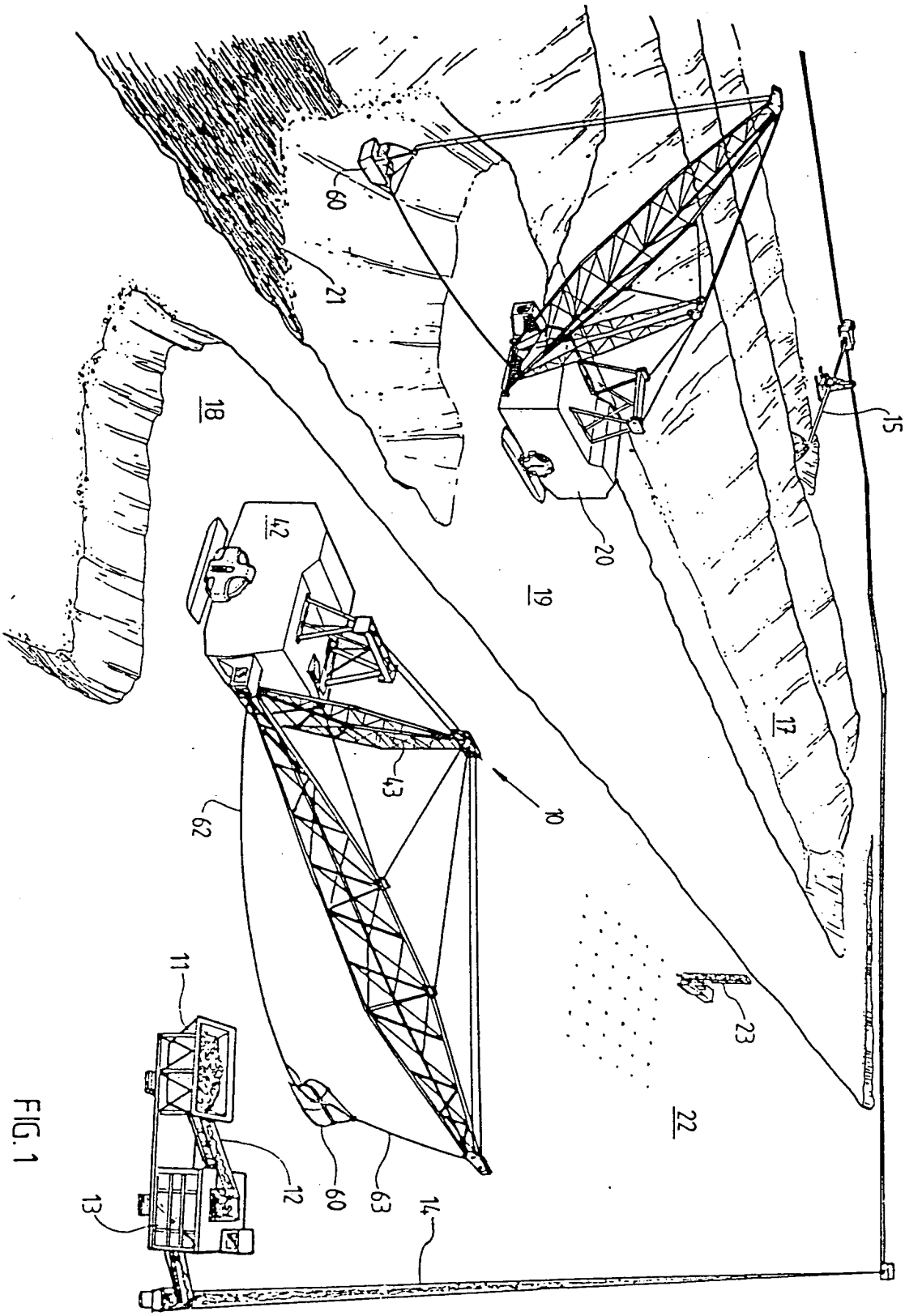


FIG. 1

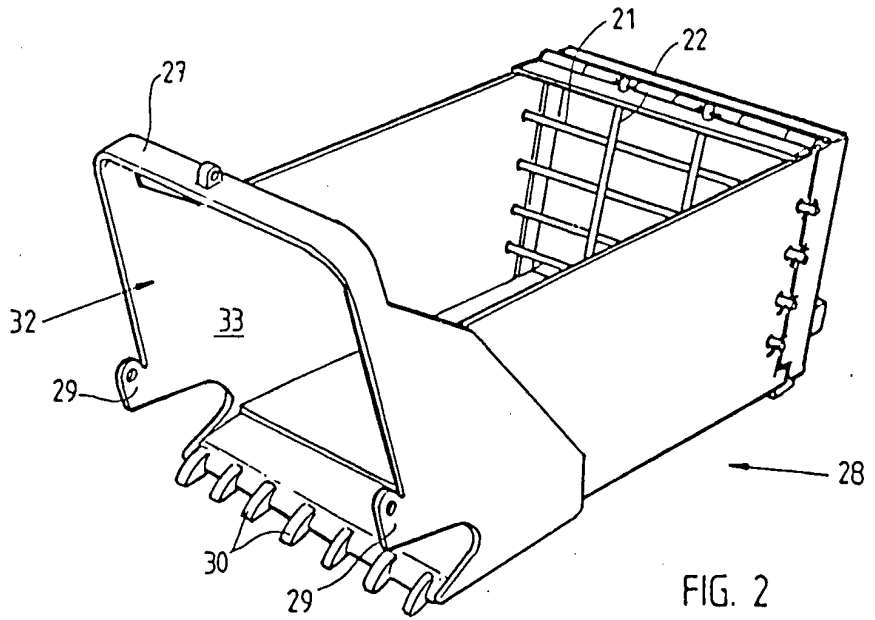


FIG. 2

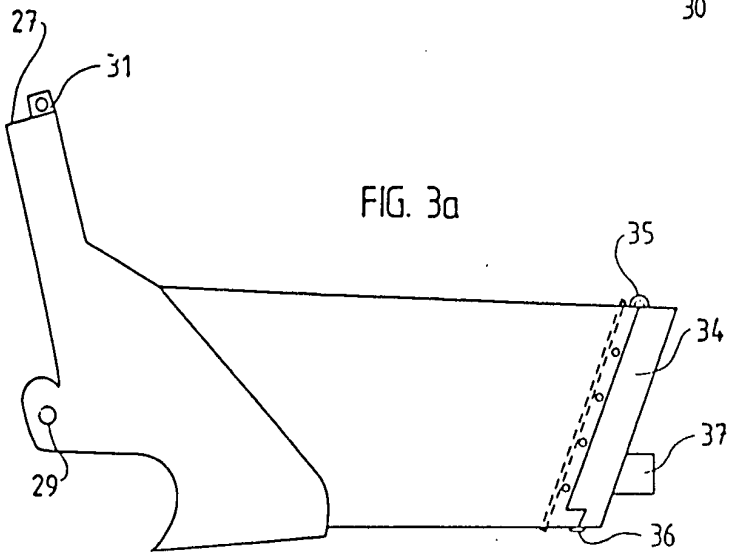
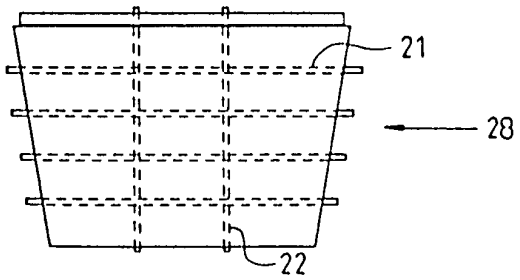


FIG. 3a

FIG. 3b



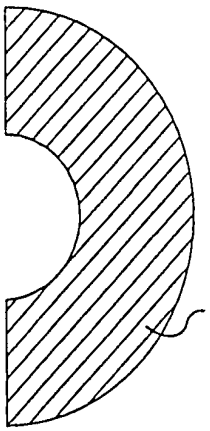


FIG. 4a

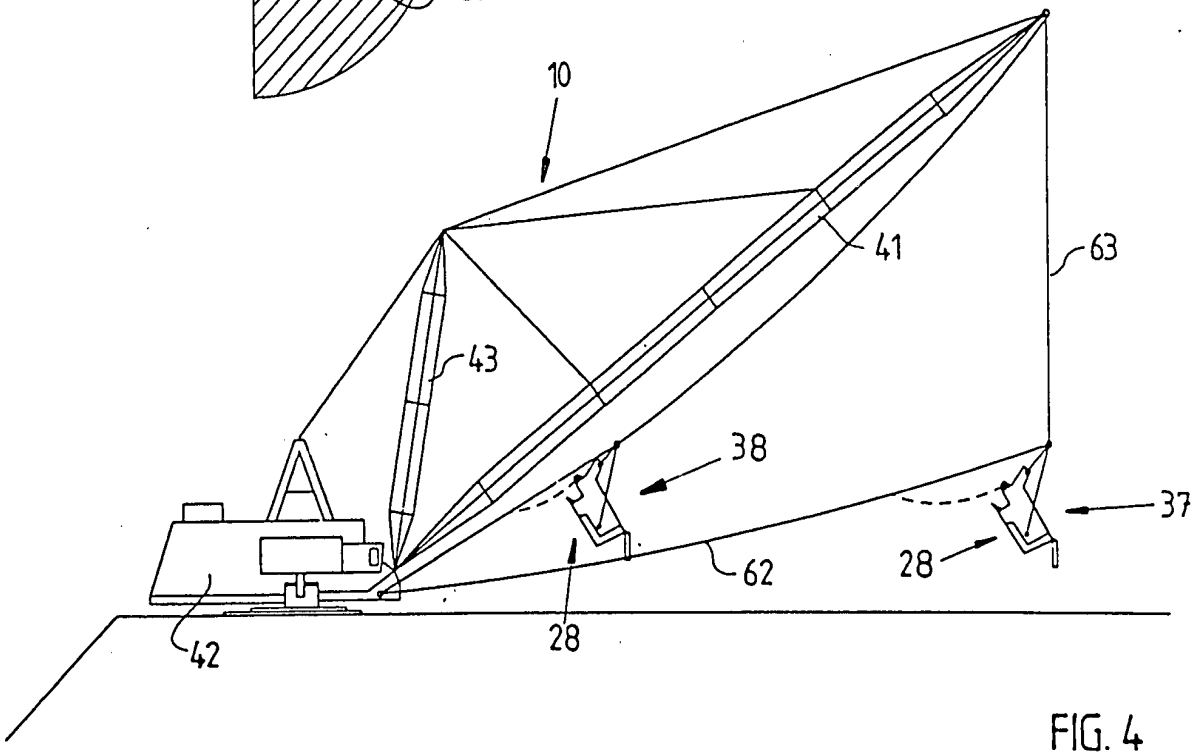


FIG. 4

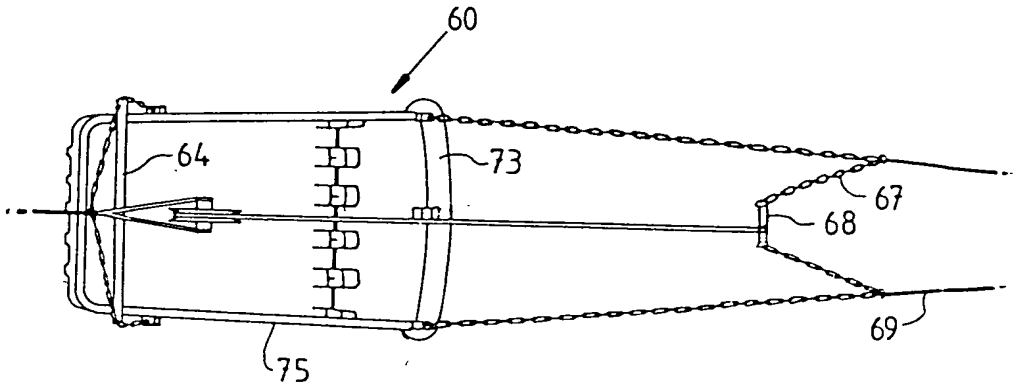


FIG. 5

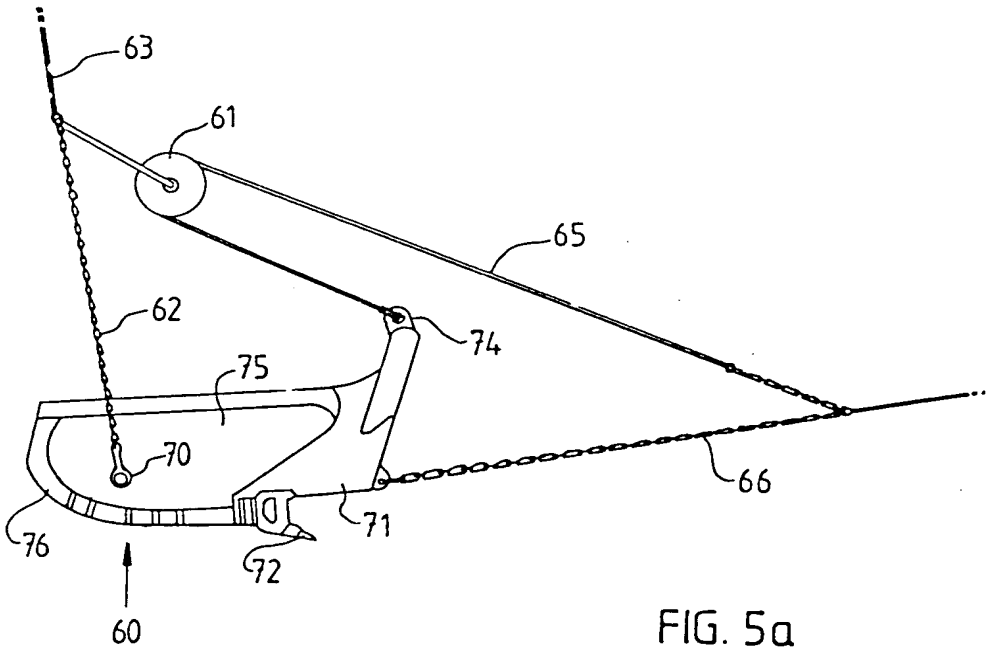
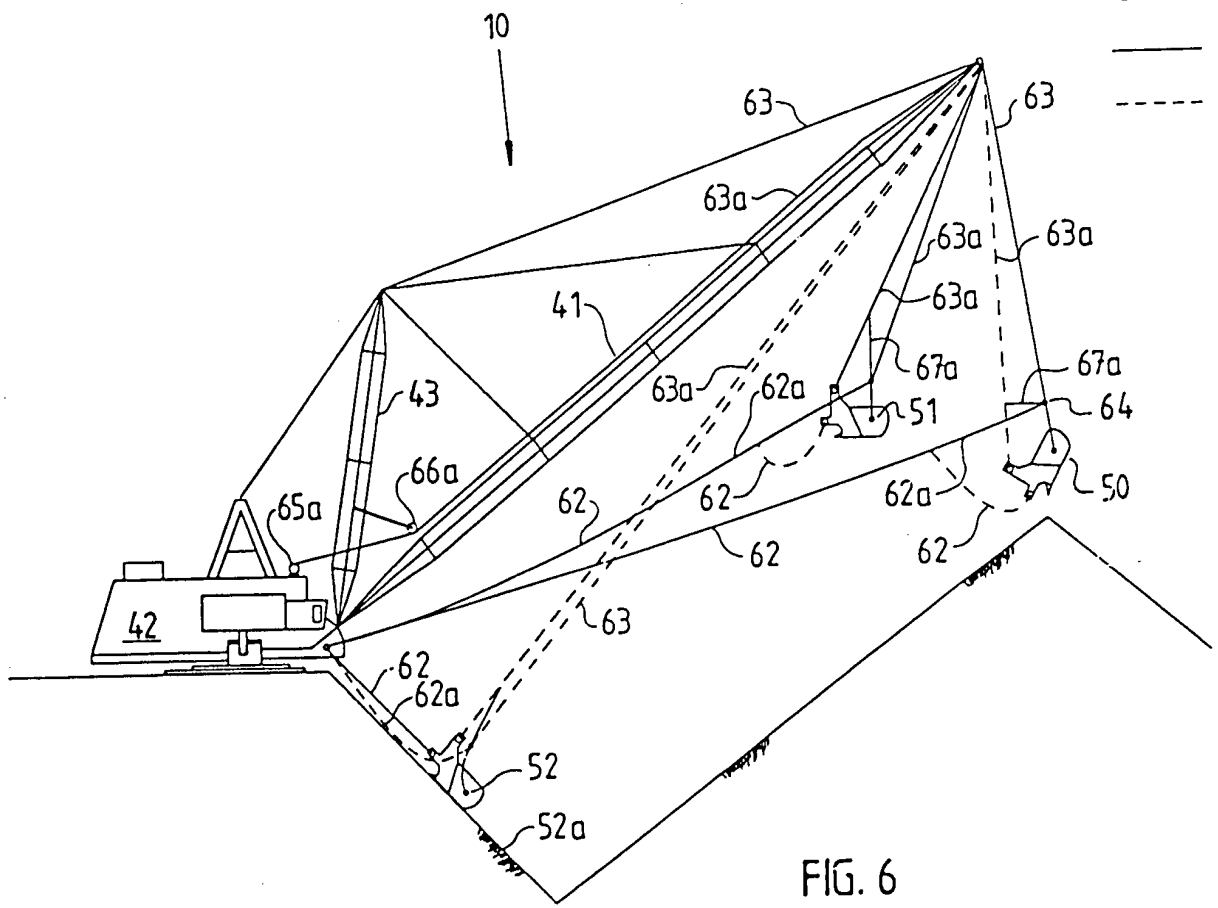


FIG. 5a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DENOTES TAUGHT CABLE
DENOTES SLACK CABLE
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63
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41
43
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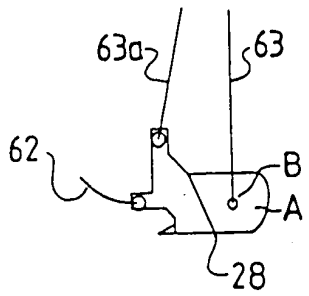
66a
42
62
62a
52
52a
67a
64
51
50

FIG. 6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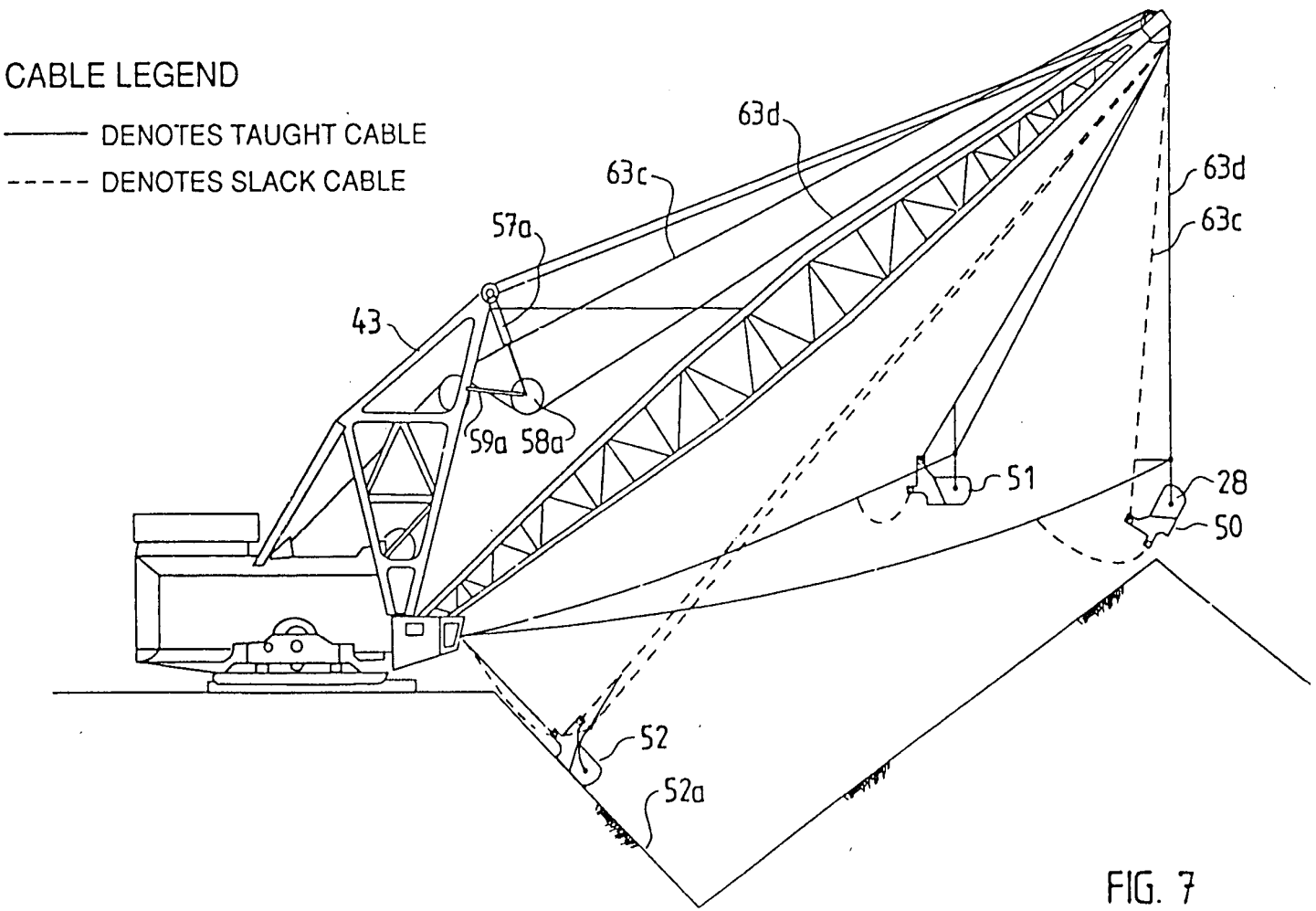
63
62
B
A
28

FIG. 6a


CABLE LEGEND
DENOTES TAUGHT CABLE
DENOTES SLACK CABLE
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63c
57a
43
59a
58a
63d
63c
51
28
50
52
52a

FIG. 7

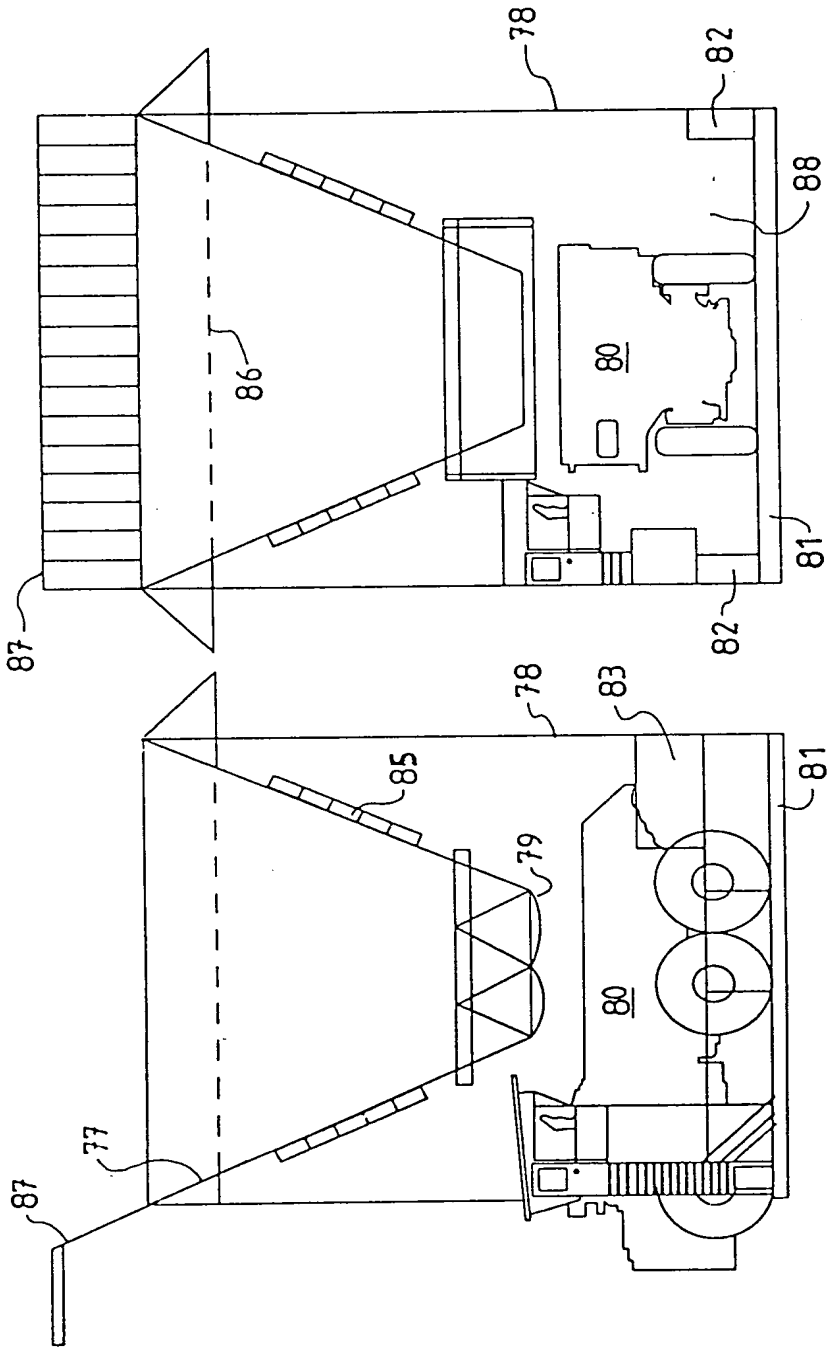
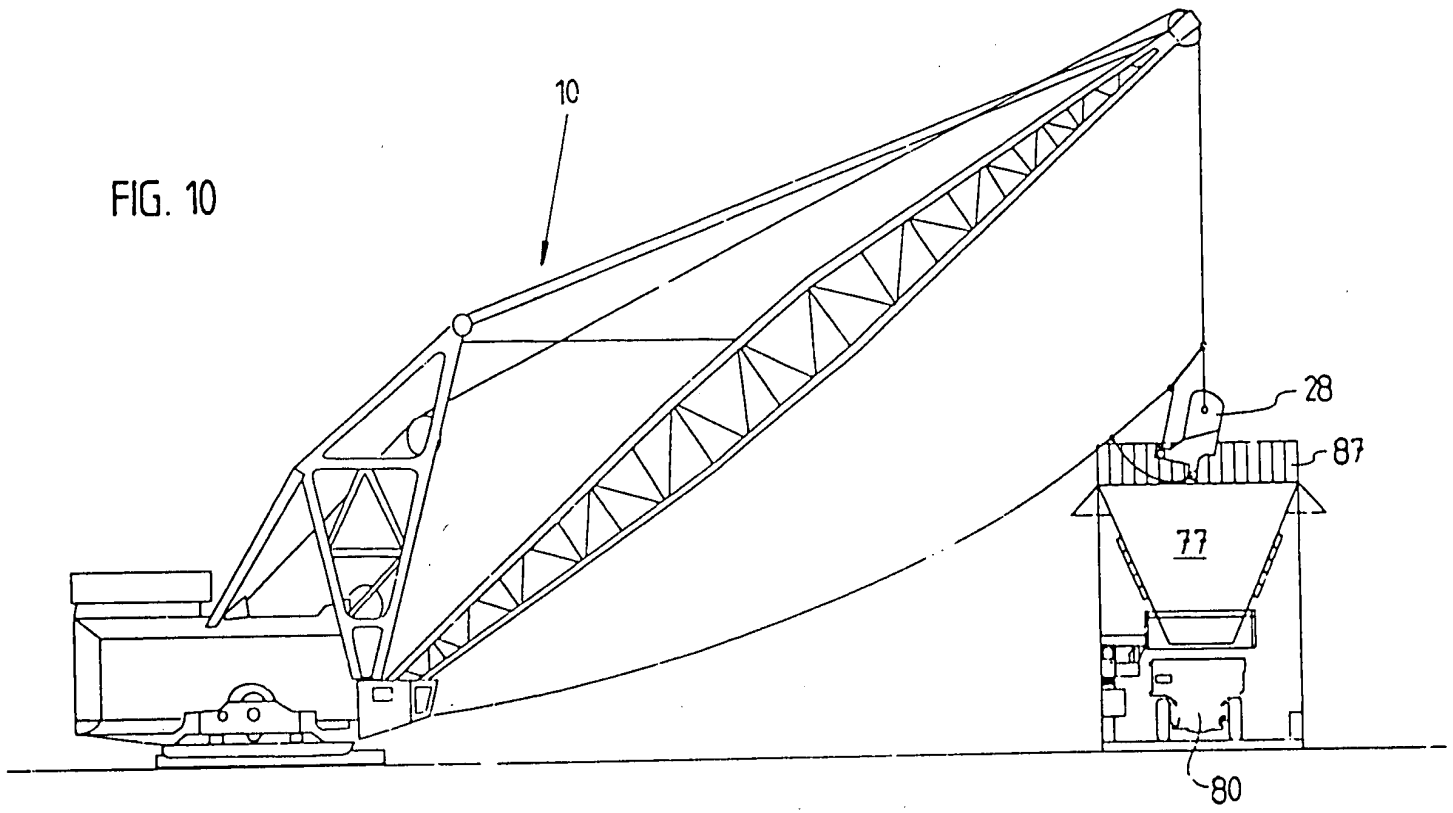


FIG. 9

FIG. 8

FIG. 10



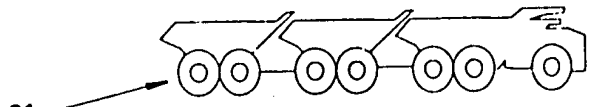


FIG. 10a

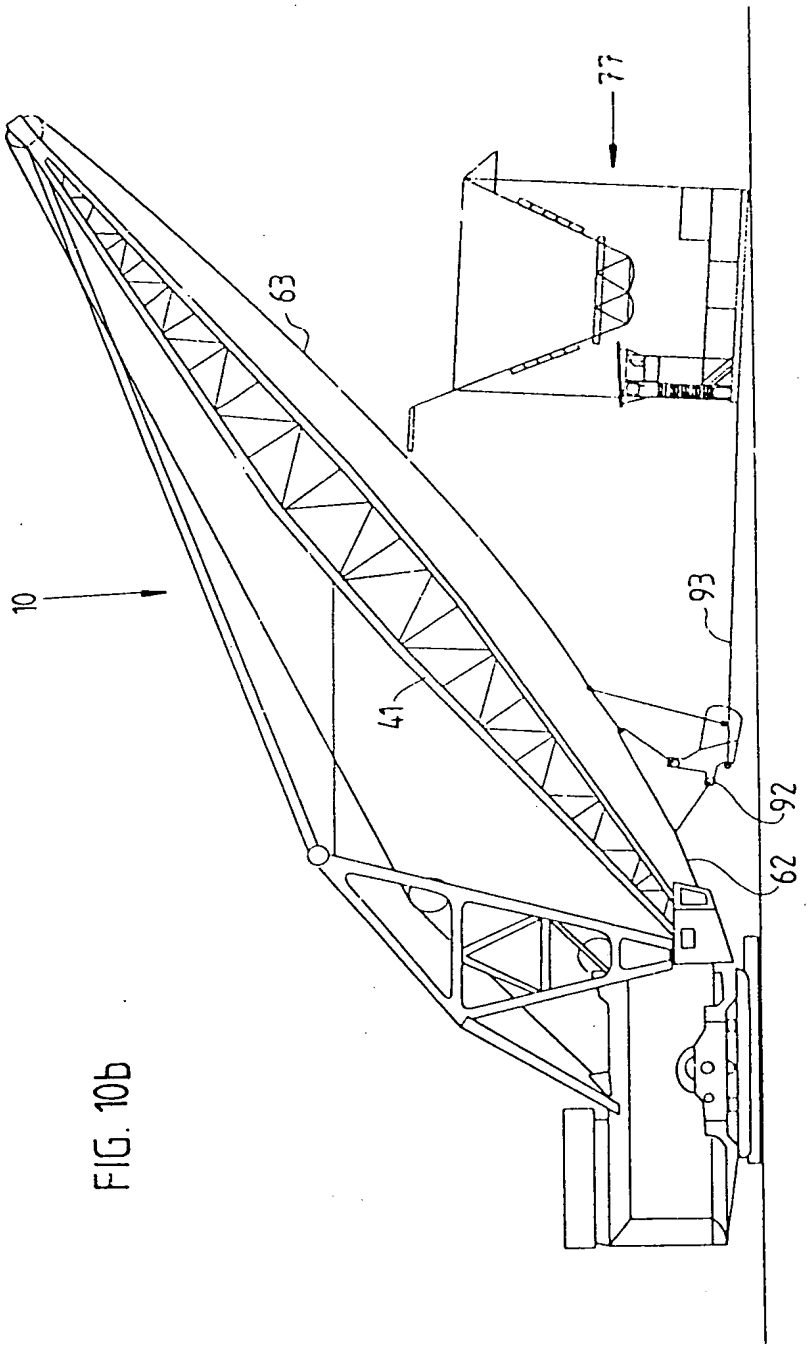


FIG. 10b

FIG. 11